

## BIO-INSPIRED ENGINEERING OF EXPLORATION SYSTEMS

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### ABSTRACT

This paper describes the multidisciplinary concept of “Bio-inspired Engineering of Exploration Systems” (BEES) and the new terminology associated with this concept. The general premise of bio-inspired engineering is to distill the principles found in successful, nature-tested mechanisms and to incorporate them into selected features /functional traits that can be enabling new endeavors; capturing the biomechatronic designs and minimalist operation principles from nature’s success strategies. BEES utilizes small, dedicated, low-power, and low-cost “biomorphic explorers” that capture selected functional traits of biological systems to obtain ‘leap-frog’ advances over existing mobile robotic systems to enable cooperative “biomorphic missions”. Space exploration presents the daunting and expensive challenge of reaching to the unknown uncharted planets. Be it for exploring new planets for NASA or dealing with the needs of DoD like surveillance of unfriendly/hazardous territories, the challenge is to deal with unpredictable situations/environmental conditions and to have the versatility of quickly adapting to unknown and unanticipated situations. Biomorphic explorers can empower a reach and sensory acquisition capability from locations otherwise hazardous/inaccessible.

Biomorphic missions are cooperative missions that make synergistic use of existing and conventional surface and aerial assets such as landers, rovers and orbiters along with biomorphic explorers. Just as in nature, where biological systems offer a proof-of-concept of symbiotic coexistence. The intent here is to distill some of the key principles and success strategies demonstrated by nature and capture them in our biomorphic mission implementations. Specific science objectives targeted for these missions include close-up imaging for identifying hazards and slopes, assessing sample return potential of target geological sites, atmospheric information gathering by distributed multiple-site measurements, and deployment of surface payloads such as instruments or surface experiments. A few candidate biomorphic mission scenarios will be described.

### REFERENCES

1. S. Thakoor, Bio-Inspired Engineering Of Exploration Systems Journal of Space Mission Architecture, (to be published 2000)
2. S. Thakoor, “Bio-Inspired Engineering of Exploration Systems”, JPL New Technology Report, September 15, 2000, NTR# 21142

## BIOINSPIRED ENGINEERING OF EXPLORATION SYSTEMS (BEES) SUBSYSTEMS BREAKDOWN

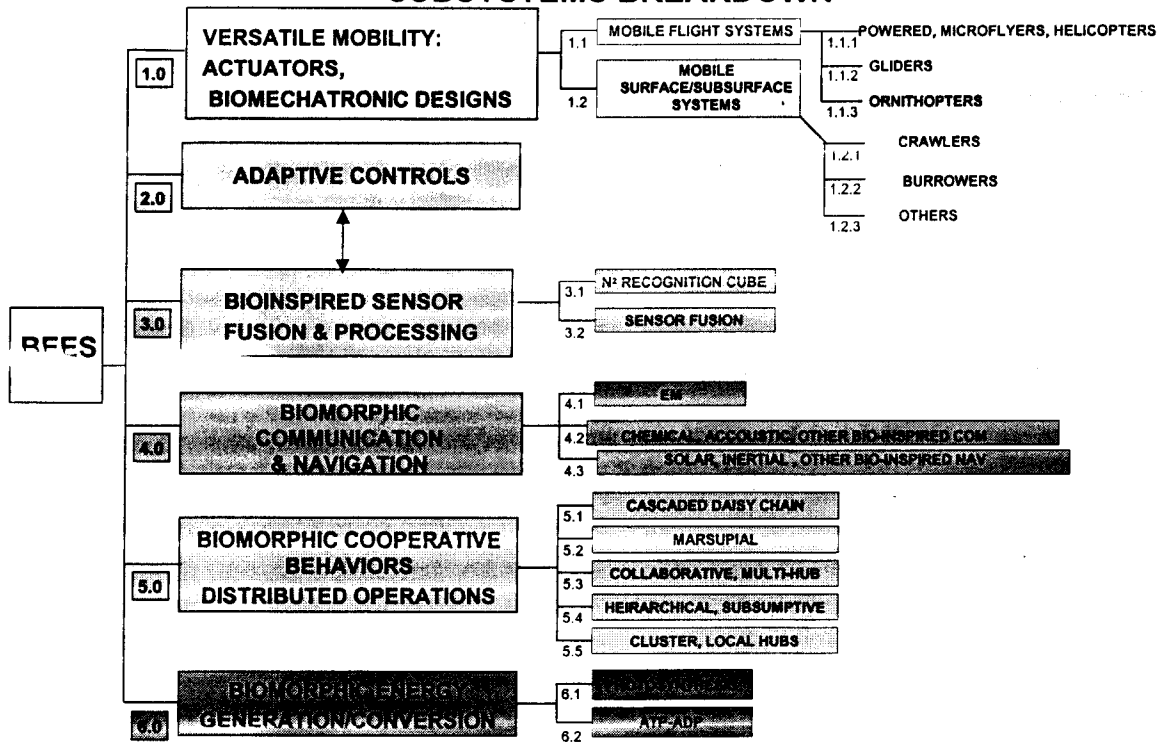


Figure 1: Subsystem breakdown for BEES

### Biomorphic Explorers: Classification (Based on Mobility and Ambient Environment) Biomorphic Explorers

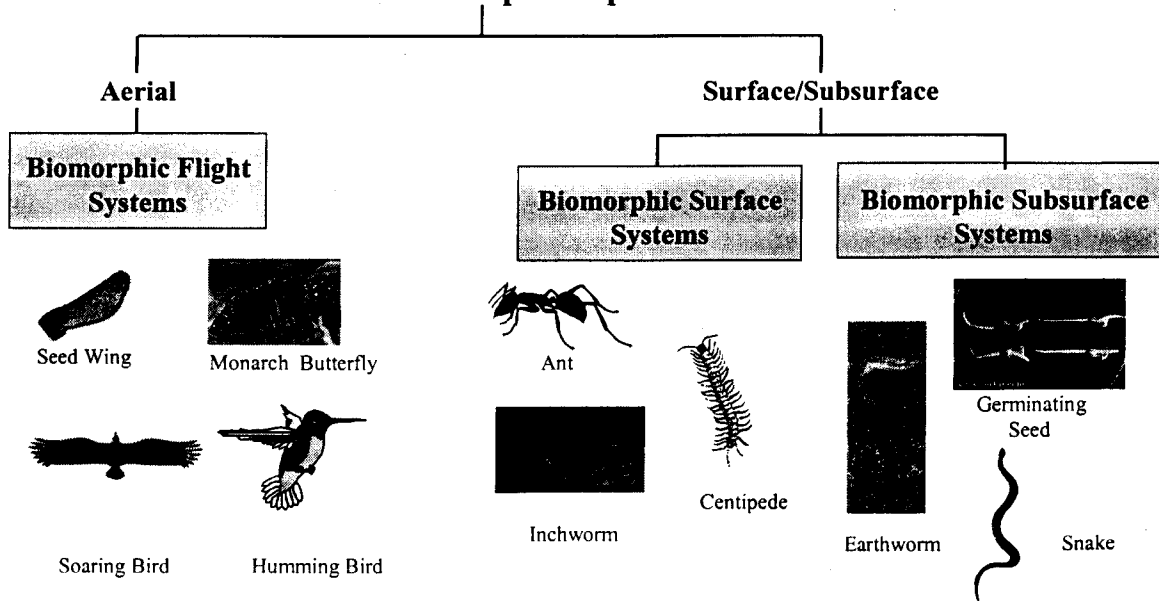


Figure 2: Examples of biological inspirations in different mobility categories